

application must provide a description of the invention sufficient to enable a person *skilled in the art to which the invention most closely pertains* to make and use the invention. It follows, in this regard, that it is not required that support for amendatory matter be verbatim but only substantive, particularly when the amendatory matter reflects a fact well-known to those skilled in the art. The specification of this application discusses flowable oxide (FOX) materials as being a class of materials having a low dielectric constant, that FOX materials are deficient in oxygen, that FOX materials can be oxidized to form  $\text{SiO}_2$ , and that, when so oxidized, the dielectric constant is increased (i.e. there is unquestionable *verbatim* support for a recitation that the dielectric constant of  $\text{SiO}_2$  is greater than the dielectric constant of FOX materials or that the FOX material is deficient in oxygen (and thus having a comparatively lower dielectric constant and susceptible of being oxidized) and thus there is clear *substantive* support for the language criticized by the Examiner) on, for example, pages 2, 5 and 11 - 12. The specification also cites a U. S. Patent to Cohen, which represents information which would be known to a person skilled in the semiconductor manufacturing arts which quantitatively compares the dielectric constants of FOX materials and  $\text{SiO}_2$  and reports that the dielectric constant of FOX materials is below 3.2 while the dielectric constant of  $\text{SiO}_2$  is about 4. Further, S. N. 09/311,470, incorporated by reference on pages 1 and 13 of this application has matured into U. S. Patent 6,329,280 (and which is disqualified as prior art due to common ownership) and also discusses the increase of dielectric constant when FOX materials are oxidized into  $\text{SiO}_2$ . Therefore, it is respectfully submitted that the specification is replete with text indicating that the dielectric constant of FOX materials is below

that of SiO<sub>2</sub> and, moreover, that fact was known to those skilled in the semiconductor manufacturing art at the time the invention was made. Accordingly, it is respectfully submitted that the language criticized by the Examiner is, in fact, substantively well-supported in the specification as originally filed and satisfies the requirements of 35 U.S.C. §112, first paragraph, in all particulars.

Therefore, it is respectfully submitted that this ground of rejection is in error and without basis in the Statute in view of the substance of the disclosure and, particularly, the knowledge of a person skilled in the art at the time the invention was made. Accordingly, it is respectfully requested that this ground of rejection be reconsidered and withdrawn.

Claims 27, 31 - 33, 36 - 41 and 43 - 46 have been rejected under 35 U.S.C. §103 as being unpatentable over Kawanoue et al. in view of the Cohen et al., claim 28 has been rejected under 35 U.S.C. §103 as being unpatentable over Kawanoue et al. in view of Cohen et al. and Lopatin et al., claims 29 - 30 have been rejected under 35 U.S.C. §103 as being unpatentable over Kawanoue et al. in view of Cohen et al., Lopatin et al and Yew et al. and claims 42 and 47 - 48 have been rejected under 35 U.S.C. §103 as being unpatentable over Kawanoue et al. in view of Cohen et al. and Usami. All of these grounds of rejection are respectfully traversed for the reasons of record and for the further reasons below, particularly since these grounds of rejection merely add Cohen et al. to the previous grounds of rejection while the statements of the rejections are self-contradictory and Cohen et al., as will be pointed out below, does not answer the claim recitations where the other references relied upon are deficient to do so.

Specifically, the paragraph bridging pages 2 and 3 of the present office action asserts that Kawanoue et

al. teaches a flowable oxide (FOX) material which it clearly does not, as previously pointed out. The Examiner relies in this regard on Figure 24 in which the Examiner identifies layer 161 as FOX. In addition to the remarks previously made of record, the Examiner's attention is called to the discussion of Figure 26 at column 20, lines 50+ in which the barrier effect of the structure of Figure 24 is evaluated. In Figure 26, the interlayer dielectric of layer 161 of Figure 24 is clearly identified as  $\text{SiO}_2$  and tantalum nitride layer 184, corresponding to layer 164 of Figure 24 is formed over another layer of  $\text{SiO}_2$  which is, in turn, formed on a layer of amorphous silicon by oxidation. Therefore it is clear that Figures 24 and 26 of Kawanoue et al. have nothing to do with a FOX material, as the Examiner admits in the first sentence of the immediately following paragraph and thus contradicts the prior statement regarding Kawanoue et al.

The Examiner then relies entirely of Cohen et al. for a teaching of a FOX material and asserts obviousness of substitution of a FOX material for the  $\text{SiO}_2$  of Kawanoue et al. notwithstanding the teaching in the present application at page 2, lines 25 - 30, that unprotected FOX materials are considered unsuitable for formation of layers and that the forms of protection for the FOX material taught or suggested by Cohen et al. are limited to deposited  $\text{SiO}_2$ , (column 3, line 66 to column 4, line 15, and column 4, lines 32 - 38), as discussed in the paragraph bridging pages 4 and 5 of the present application. Cohen et al. does not teach or suggest forming a protective layer of  $\text{SiO}_2$  by oxidation of the FOX material, particularly in the trenches formed therein as the primary protection barrier for the FOX materials.

The barrier in the trenches formed by oxidation of the FOX materials forms a barrier which has numerous

beneficial properties and advantages in comparison with a deposited  $\text{SiO}_2$  protection barrier as described on page 11, line 29 to page 12, line 23, not the least of which is that the barrier can be made impervious to moisture, resist developers and other process chemicals and copper extrusion while very thin (e.g. less than 20% of the FOX layer thickness or less, as disclosed) and therefore the low dielectric constant of the FOX material is not significantly compromised by the small thickness of  $\text{SiO}_2$  formed during oxidization of the FOX and which has a higher dielectric constant than the FOX material.

Therefore, it is respectfully submitted that the combination of Kawanoue et al. and Cohen et al. does not answer the recitations of "said primary protective layer being a thin oxidized surface of said FOX" (claim 27) or "said thin protective layer being an oxidized surface of said flowable oxide" (claim 38) and results in a substantially different and distinct structure from that which would result from the modification of Kawanoue et al. in accordance with the teachings and suggestions of Cohen et al. Further, this combination of teachings and suggestions does not provide evidence of a level of ordinary skill in the art which would support the conclusion of obviousness which the Examiner has asserted since the combined teachings do not lead to an expectation of success in substantially maintaining the low dielectric coefficient of the FOX material while protecting the FOX material from copper extrusion from Damascene conductors as well as moisture and process chemicals (a problem specific to FOX materials and aggravated by the reduced separation of structures necessitating their use; not addressed or recognized by either reference) by the very simple and high manufacturing yield expedient of oxidizing the surface of the FOX material, especially within the trenches. Therefore, the basic combination of Kawanoue

et al. and Cohen et al., asserted in all of the grounds of rejection of record does not support a conclusion of obviousness of any claim in the application. Moreover, the Examiner has not asserted that Cohen et al. teaches anything of relevance to forming a protective layer by oxidizing a surface of the FOX material and thus the Examiner has failed to make a *prima facie* demonstration of obviousness of any claim.

The teachings of the combination of Kawanoue et al. and Cohen et al. is not supplemented as to this point of deficiency by either Lopatin et al., Yew et al. or Usami and the Examiner has not asserted that they do, as pointed out in the previous response. Therefore, it is respectfully submitted that a *prima facie* demonstration of obviousness has not been made and cannot be made even considering all five references in any combination.

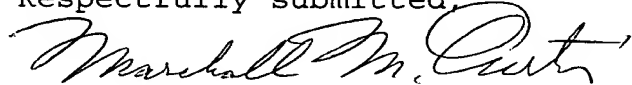
Accordingly, it is respectfully submitted that all of the grounds of rejection stated by the Examiner are in error and unsupported by the teachings, suggestions and/or evidence of the level of ordinary skill in the art provided therein. Therefore reconsideration and withdrawal of the rejections of record are respectfully requested.

Since all rejections, objections and requirements contained in the outstanding official action have been fully answered and shown to be in error and/or inapplicable to the present claims, it is respectfully submitted that reconsideration is now in order under the provisions of 37 C.F.R. §1.111(b) and such reconsideration is respectfully requested. Upon reconsideration, it is also respectfully submitted that this application is in condition for allowance and such action is therefore respectfully requested.

If an extension of time is required for this response to be considered as being timely filed, a conditional petition is hereby made for such extension

of time. Please charge any deficiencies in fees and credit any overpayment of fees to Deposit Account No. 09-0458 of International Business Machines Corporation (E. Fishkill).

Respectfully submitted,



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